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A REVIEW OF THE PANORPIDAE OF AMERICA NORTH OF MEXICO.

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It is a difficult matter to give characters that will define the forms that are at present placed in this Neuropteroid family. The majority of the members are readily distinguished by the beak-like front of the head. The antennae are long, slender, and many jointed; there are three ocelli or none, and the compound eyes are rather large. Most of the species have four well developed wings but some are wingless or at most have rudimentary wings. The type of the family is *Panorpa communis L.*, the common scorpion fly of Europe, The American species have been catalogued by Banks in Trans. Am. Ent. Soc., Vol. 19, 1892.

The family formerly included the genus *Nemoptera* which Klug considered, but eliminated from the *Panorpidae* in his Monograph of Panorpatae in Abhandlungen der Academie der Wissenschaften zu Berlin in 1836.

The life history of only a few species is known. In Europe Brauer has done some work which is frequently quoted, and in this country Felt has published a paper in Lintner's Tenth Report of the Insects of New York, in which he records observations on some very young stages of *Panorpa rufescens* Rambur.

The material which I have examined in the preparation of this paper aggregates nearly a thousand specimens. Through the kindness of officers in charge I was permitted to examine the material, both domestic and foreign, in the Museum of Comparative Zoology at Cambridge. I desire to express my obligation to Mr. Nathan Banks of the Division of Entomology, Washington, D. C., for suggestions, and the loan of his collec-

tion which contains specimens, with one exception, of all the North American species of *Panorpa*, and also the officers of the National Museum for the loan of their collection in the family. Dr. E. P. Felt and Mr. C. C. Adams and others have assisted me materially in the loan of specimens. After getting this collection together I find that a large part of North America is represented but more material from our southern states would have been desirable.

Key to genera.

The following key is offered for the separation of the genera:

1. Ocelli present 3
   Ocelli absent 2
2. Wings well developed, anntennae short, thick, and narrowed at the apex. Appendages of the male very long, with an articulation near the middle, . *Merope.*
   Wings of female rudimentary, of male imperfect, antennae filiform, ... *Boreus.*
3. End of the abdomen in the male developed into the form of a chelifer, antennae long and filiform, . . 4
   End of the abdomen in the male not developed into the form of a chelifer, abdomen cylindrical, antennae shorter, and gradually decreasing in size towards the tips, *Bittacus.*
4. Tarsal claws toothed, abdominal segments 7 and 8 modified, and elongated, rostrum elengated, . *Panorpa.*
   Tarsal claws simple, abdominal segments 7 and 8 of the male short, similar to the preceding segments, rostrum short, triangular, ... *Panorpodes.*

Panorpa Linn.

The species of this genus have four well developed wings, which in our species are banded or spotted with dark brown. The head is produced downward into a beak, and the mouth parts are borne at at the end. The mandibles are slender and two-toothed at the apex; the antennae are only slightly smaller at the apex than at the base; the legs are rather short, and each tibia bears two strong spines at the apex of its inner surface.

The genus was indicated by Linnaeus about 1767 in his Systema Naturae. Species which at the present time are

placed in at least four distinct genera, were described as belonging to the genus. Gradually as insects have become better classified, *Panorpa* has been restricted to its present limits.

Besides the considerations which Klug gave in his paper referred to above, Westwood has published a monograph of *Panorpa* in the Transactions of the Entomological Society of London for 1846. Hagen gave descriptions of the then known American species in his Synopsis of Neuroptera in 1861. Mc Lachlan, in the Trans. of the Ent. Soc. of London for 1868, considered the European species, and a number of species from Japan. Banks gave a synopsis of American species in the Trans, of the American Ent. Soc. Vol. 22, 1895.

The members of the genus seem to subsist mainly upon animal matter that they find dead, but Davis has recorded in Bulletin 15 of the Arkansas Experiment Station that he has observed a species of *Panorpa* preying upon the cotton worm. Felt has made the interesting statement, that in his experience they paid no attention to living, healthy larvae, but when he placed a living, injured larva in the breeding cage where specimens of *Panorpa* were confined, they immediately set to work sucking juices from the wound. I have observed a specimen feeding on a Dipteron which from appearances was dead before it was attacked by the *Panorpa*.

The characters which have been used in separating the various species are many; formerly the number of teeth on the claws and the size of the horn on the sixth segment of the male were considered of value, but for American forms these appear to be of little consequence. The characters found in the wings have long been used. The wing pictures although variable are certainly of value and the length of the sub-costa, that is, whether it unites with the costa at the pterostigma, or before it, as used by McLachlan in 1868 in connection with European species is of value, but subject to some variation. In the male, the form of the 7th and 8th abdominal segments, the presence or absence of a horn on the sixth segment, and the genital organs are worthy of consideration.

Key to Panorpa

In this paper I consider fifteen species, which seem to fall naturally into five groups. I offer the following key to aid in separating them. The dark colored apex of the wing is considered as a band.

I. Seventh and eighth abdominal segments and forceps of the male much elongated, no horn on sixth segment; subcosta uniting with the costa far before the pterostigma, ... Group *lugubris.*

Wings black with narrow hyaline cross bands, *lugubris.*

Large species, wings yellow with three wide black bands, pterostigmal band not forked behind, *nuptialis.*

Smaller species, pterostigmal band forked behind, *rufa.*

II. No horn on sixth abdominal segment of the male, wings with irregular markings, not usually in the form of bands, ... Group *nebulosa.*

1. Sub-costa uniting with the costa far before the pterostigma, 3.

Sub-costa uniting with the costa at the pterostigma, 2.

2. Large species, pterostigmal band of wing entire, *latipennis.*

Smaller species, rarely with any entire bands on the wings, ... *nebulosa.*

3. Radial vein curves inward to form the pterostigma, *maculosa.*

Radial vein nearly straight at pterostigma, . *banksii.*

III. Horn on sixth segment of the male, wings hyaline, with three entire black bands on the forward pair; from side view a prominent elevation apparent on the basal part of the claws of the male forceps, Group *subfurcata.*

Elevation on the basal part of the claw of the male forceps rounded, about one-half as long as the claw; wings rather narrow, ... *signifer.*

Elevation on the claw of the male forceps oblong, reaching for more than half the length of the claw; wings wider, ... *subfurcata.*

IV. Horn on the sixth segment of the male, wings yellowish with three black bands, basal band rarely interrupted, ... Group *americana.*

Bands on wings regular, wings wide and regularly rounded at the end, ... *americana.*

Bands on wing irregular, wing narrower, . *venosa.*

V. Wings yellowish or hyaline, but not more than two complete black bands, horn on sixth segment of the male abdomen, seventh and eighth segments rather long, about equal in length, seventh rapidly enlarged above just before the middle, . . Group *confusa.*

1. Wings hyaline, posterior border more strongly curved than usual, the veins dark colored, . . *claripennis.*

Wings yellowish, markings confused, pterostigmal band interrupted or geniculated at the middle, uncus short reaching but little beyond the base of claws of forceps, ... *confusa.*

Wings pale, more yellowish at base, uncus reaching to middle of claws of forceps, ... 2

2. Wing markings of usual extent, larger species, *rufescens.*

Wing markings reduced, harpes of male not reaching base of claws of forceps, smaller species, . *canadensis.*

Panorpa lugubris, Swederus.
Plate LIX, Fig. 7.

Panorpa lugubris, *Swederus,* Kongl. Vetensk. Acad. Handl. 8-279; *Klug,* Monog. Panorp. 106; *Westwood,* Trans. Ent. Soc. of London 4-188; *Hagen,* Neuroptera of N. A. 241.

Panorpa scorpio, *Fabr,* Ent. Syst. 2-97; *Rambur,* Neuropt. 331.

Bittacus scorpio, *Latr,* Gen. Crust. Ins. 3-189.

Anterior wing 11–13 mm. Head and thorax black; abdomen in the male brown, except the apical segment which is black; abdomen in the female black ventrally, and at the apex; wings black, anterior pair each with an oblique band on the middle, a costal spot before the pterostigma, one on the posterior margin behind the pterostigma, and one or more between the middle band and the base; hind wings similar, but the oblique band is usually interrupted; there is some variation in the width of the bands, and size of the spots on the wings, but the species is one of the most distinct of the genus.

Specimens are at hand from Ga. and Fla. and Hagen reports it from S. Car.

Panorpa nuptialis Gerst.

Plate LIX, Fig. 2 Plate LXI, Figs. 26, 33.

Panorpa nuptialis, *Gerstaecker*, Stet. Ent. Zeit. 1863, 24-178.

Anterior wing 15–18 mm. Light brown to fuscous, color nearly uniform over the whole body; the front femora, and bases of the middle and hind femora are usually lighter than the remaining parts of the legs, although there is some variation from this, at least in museum specimens. The antennae are uniform fuscous with one or two basal joints lighter; the wings are yellow with the apex, a pterostigmal band, a costal spot of more or less extent, an oblique band and some basal markings black; the basal markings are variable, but are usually found along the borders of the wing; the marking on the posterior border reaches from base to first cross band, the one on costa begins at base, widens abruptly, and terminates before reaching the first cross band. The bands on both wings are straight and well defined, and the basal markings are usually of less extent on the hind wings. The 6th abdominal segment lacks the dorsal horn and the 7th and 8th segments are long and slender. The largest North America species of its genus.

Habitat, Texas, Louisiana and Mississippi.

Panorpa rufa G. R. Gray.

Panorpa rufa, *G. R. Gray*, Griffith's Edit. Cuvier's Anim. King. 15-323, Plate 105, Fig. 2; *Westwood*, Trans. Ent. Soc. of London 4-188; *Walker*, Cat. 461; *Hagen*, Neuropt. N. A. 242.

Panorpa fasciata, *Klug*, (in part) Mon. Panorp. 105.

Expanse according to Westwood 12½ lines, according to Hagen 27 mm. Wings elongate, yellow, sub-acute at apex, two basal spots, an oblique band before the middle, a pterostigmal band forked behind, and apex black. Four minute hyaline spots enclosed in the black apex. Abdomen of the male elongate, segment 6 unarmed—From the description of Westwood.

Habitat, Ga.

I have seen no specimens as yet that answer to this description. It is possible that *nuptialis* may be this species but

the form that I have identified as *nuptialis* averages nearly ten millimeters larger; and of more than twenty specimens before me none have the pterostigmal band forked behind.

Panorpa maculosa Hagen.

Plate LIX, Fig. 6.

Panorpa maculosa, *Hagen*, Neuropt. N. A. 245.

Anterior wing 11–13 mm. Wings hyaline, maculate with numerous small, brown, irregular spots; nearly all the cross veins more or less bordered with brown, first vein uniting with costa near the middle of the wing—far before the pterostigma.

The wing markings in this species are somewhat variable. Some specimens have quite distinct spots, while in others the brown is confined almost entirely to the margins of the cross veins.

Hagen's types, a male and a female, are in the Museum of Comparative Zoology at Cambridge.

Habitat New York; Del.; Ohio; Penn.

Panopa nebulosa Westwood.

Plate LX, Fig. 21.

Panorpa nebulosa, *Westwood*, Trans. Ent. Soc. of London 4-191; *Walker*, Cat. 464; *Hagen*, Neurop. N. A. 243.

Anterior wing 11–13 mm. It is hardly worth while to give a full description of this species; it has the appearance of *maculosa* and the wing markings pass through the same variations as in that species. The difference which I mentioned in the key, namely; in *nebulosa* the sub-costa reaches the pterostigma, while in *maculosa* in ends near the middle of the wing, is the only distinctive character I offer.

Habitat, Mich.; Penn.; N. Y.; Ohio.

Panorpa banksii.

Plate LXI, Fig. 28.

Panorpa affinis, *Banks*, Trans. Am. Ent. Soc. 1895, 22-315.

Anterior wing 11 mm. Fulvous, abdomen luteous; wings hyaline, veins fuscous, a slender apical band and an interrupted pterostigmal one, a middle spot on costa, an interrupted

band, and a basal spot brown; sub-costa runs into costa at middle of the fore wing; the radius does not curve inward as much at the pterostigma as in *P. maculosa* and the wing is less slender than in that species. Abdomen short, second segment not produced behind; 6th segment tapering, no projection above; 7th an 8th sub-equal, 7th ob-conical, curved at base, more swollen above than in *P. maculosa*, 8th more regularly conical and not so large; 9th short and broad; forceps stout, appendages reaching to base of claws.

Habitat, Sea Cliff, N. Y. Differs from *P. nebulosa* and *maculosa* in shorter and stouter forms.

I have seen only the type specimen of this species. It is a male and is deposited in the Banks collection.

As *affinis* has been used by Leach for a European species, it seems desirable to change the name of the American species, although *affinis* of Europe is not considered a distinct species at the present time.

Panorpa latipennis n. sp.

Plate LIX, Figs. 1, 3. Plate LXI, Fig. 32.

Anterior wing: male 14 mm., female 16 mm. Brown, last three or four abdominal segments lighter, rostrum and basal segments of the antennae brown, remainder of antennae fuscous; coxae fuscous, remainder of legs pale yellow; wings hyaline, apex, a pterostigmal band geniculated at the middle, and abruptly widened at costa, a costal spot, a band interrupted at middle, and a basal spot brown. The apical patch of brown is divided or nearly divided by hyaline, the basal spot is absent on the hind wings, all the wing markings are very narrow and somewhat broken, and most of the veins are brown. There, is no horn on the 6th segment of the male. A male and female in the Hubbard and Schwarz Collection taken at Detroit, Michgan, June 2, and a female in the Banks Collection taken in New York.

The large size separates this species from others of its group.

Panorpa subfurcata Westwood.

Plate LXI, Figs. 25, 30.

Panorpa subfurcata, *Westwood*, Trans. Ent. Soc. of London 4-191 ; *Walker*, Cat. 464 ; *Hagen*, Neuropt. N. A. 244.

Anterior wing 14 mm. Brown, antennae black excepting two basal joints which are light brown like the head, the apex of the rostrum is dark, and the tarsal joints are annulate with fuscous; wings hyaline, one or two basal spots, an irregular arcuate band before the middle, a costal spot, a pterostigmal band gradually widened before and interruptedly forked behind, and apex dark brown; the basal spots and band before the middle are usually connected on the anterior wing, and reduced and broken on the posterior wing. Forceps of male, when viewed from the side, with a very prominent elevation which ends anteiorly in a short blunt projection.

Habitat, Nova Scotia; N. Y.; Mich.; New Hamp.; and Hudson's Bay.

Panorpa signifer Banks.

Plate LIX, Fig. 8. Plate LX, Fig. 12.

Panorpa signifer, *Banks*, Trans. Am. Ent. Soc. 26-251.

Anterior wing in the male 12 mm. female 13 mm. Color reddish, mouth parts darker, two basal joints of the antennae pale, the remainder dark brown or black; legs the color of the body excepting the tarsi which are darker, all the joints excepting those uniting femur and tibia with dark annulations; wings hyaline, two basal spots, an irregular band before the middle sometimes interrupted, a costal spot, one behind it on posterior border, a pterostigmal band forked behind and abruptly widened before, and apex enclosing some hyaline spots dark brown; on the hind wings the basal spots are usually absent, the band before the middle may be interrupted, and the forks of the pterostigmal band may be disconnected. The male forceps when viewed from the side show a characteristic obtuse prominence above.

This is a well marked species and specimens are at hand from Michigan, Pennsylvania and New York. The type is in the Banks Collection.

The narrow wing and peculiar prominence on the forceps of the male, serve to identify it readily.

Panorpa americana Swederus.

Plate LIX, Fig. 5.

Panorpa americana, *Swederus*, Kongl. Vetnsk. Acad. Handl. 8-279; *Westwood*, Trans. Ent. Soc. of London 4-189; *Hagen*, Neuropt. N. A. 242.

Panorpa fasciata, *Fabricius*, Ent. Sys. 2-98; *Klug* (in part), Mon. Panorp. 105.

Anterior wing 12 mm. Body brown; wings yellowish; an elongate, basal spot, an oblique band before the middle, a dorsal spot, a pterostigmal band, and apex black. The wing bands are straighter, and much more regular than in any other American species except perhaps *nuptialis*. The form of the wing is striking, being broad and rounded at the apex as shown in the figure. The 6th abdominal segment of the male bears a short horn.

Habitat, Ala.; Ga.

Panorpa venosa Westwood.

Plate LIX, Fig. 4. Plate LX, Figs. 18, 23. Plate LXI, Fig. 38.

Panorpa venosa, *Westwood*, Trans. Ent. Soc. of London 4-190; *Walker*, Cat. 463; *Hagen*, Neuropt. N. A. 242.

Panorpa fasciata, *Klug* (in part)Mon. Panorp. 105.

Anterior wing 11-13 mm. Wings yellow, a basal spot, a band before the middle rarely interrupted, a costal spot, a pterostigmal band widened before, and apex black. Horn on 6th abdominal segment of the male, 7th segment ob-conical increasing gradually in size from near the base, 8th segment usually shorter than the 7th.

This species is easily separated from *americana* by the narrower wings with irregular bands, and from the *confusa* group by the form of the 7th abdominal segment, and also in nearly always having three complete bands on wings.

Habitat, Mich.; New Jersey; Va.; Md.; D. C.; Tenn.; Ohio; Penn.; Ga.; Ill.

Panorpa confusa Westwood.

Plate LX, Fig. 13. Plate LXI, Figs. 27, 34.

Panorpa confusa, *Westwood*, Trans. Ent. Soc. of London 4-190; *Walker*, Cat. 463; *Hagen*, Neurop. N. A. 244.

Anterior wing 12 mm. Fulvous; wings uniform yellowish, a median basal spot with one or two small spots on costa above it, an interrupted band before the middle, a small costal spot, a pterostigmal band geniculated or interrupted at middle, a small spot on posterior border and apex black. Many of the cross veins are margined with fuscous. Uncus of the male short, at most not reaching far beyond the base of forceps.

This species agrees with Westwood's description so well that I feel a certain amount of satisfaction in identifying it as *confusa*. Although most specimens have the ground color of the wings uniformly yellowish there is some variation, and specimens are before me that have these parts hyaline, with the veins dark brown or black. The pterostigmal band is often interrupted and in some cases when it is entire, the posterior part is double.

Habitat, Penn.; N. Y.; Md.; D. C.; Ohio; Mich.; Va.; Ill.; N. C.; Mass.

Panorpa rufescens, Rambur.

Plate LIX, Fig. 10. Plate LX, Figs. 11, 22. Plate LXI, Fig. 31.

Panorpa rufescens, *Rambur*, Neurop. 330; *Felt*, Lintners Tenth Report Ins. N. Y. 464; *Hagen*, Neurop. N. A. 241.

Panorpa debilis, *Westwood*, Trans. Ent. Soc. of Lon. 4-191; *Walker*, Cat. 464; *Hagen*, Neurop. N. A. 243.

Panorpa germanica var., *Walker*, Cat. 459 (?).

Anterior wing 11–13 mm. Wings slightly tinged with yellowish, more apparent at base; a basal spot, a band interrupted before the middle, a costal spot, a pterostigmal band and apex black. Uncus of the male long, unusually reaching to the middle of the claws of the forceps; although, this species has somewhat the appearance of *confusa* at first sight, it is quite distinct; the form as well as the markings of the wings is different as the figures show. The uncus besides being longer, is heavier and much more prominent.

I have compared this species carefully with the original description of Westwood and Rambur. I feel confident now that they pertain to the same species, and this one appears to answer exactly.

There is some variation especially in passing from one sex to the other. The males are considerably smaller and slenderer than the females, and as a usual thing the wings of that sex are paler.

Habitat, N. Y.; Mich.; N. J.; Ohio; Penn.; Ga.; D. C.; Md.; Canada.

Panorpa canadensis Banks.

Plate LX, Fig. 24. Plate LXI, Fig. 39.

Panorpa canadensis, *Banks*, Trans. Amer. Ent. Soc. 1895, 22-315.

Anterior wing 11 mm. Reddish, antennae black, black around the ocelli. Legs and abdomen pale yellowish. Wings hyaline; an apical band broken up on posterior side, a slender geniculate, pterostigmal band, a yellowish costal spot, two spots of a basal band, and a very small basal spot dark brown. Wings a little more slender than in *P. rufescens*, subcosta extending to pterostigma. Abdomen short, second segment not produced behind, 6th segment of the male cylindrical with a stout projection above, 7th and 8th segments sub-equal, 7th with base slender, quite suddenly swollen above, 8th gradually enlarging but not as large as the 7th, 9th short, forceps short, stout, appendages short, not reaching to base of claws.

Habitat, Sherbrooke, Canada and Mt. Washington, N. H.

This species is of the form and appearance of *rufescens*. It is smaller than specimens of that species usually are, and the wing markings are reduced. The type is in the Banks Collection.

Panorpa claripennis n. sp.

Plate LX, Fig. 14. Plate LXI, Fig. 36.

Anterior wing of male 13 mm. General color light brown, darker on notum; apex of tibia and tarsal joints black. antenna black, excepting the two basal joints which are colored like the head; wings hyaline, a very minute basal spot, a band interrup-

ted before the middle. a minute spot in third interspace, an oblique pterostigmal band widened before and behind, some scattered spots, and extreme apex dark brown on the fore wing. Band before middle almost obselete, and pterostigmal band widely interrupted on the hind wings.

The form of the wing in this species is peculiar in that the posterior border is nearly a regular curve from base to apex, making the wing wide near the middle. This is shown in the figure. The type is in the Banks collection.

Habitat, Sherbrooke, Canada.

PANORPODES McLachlan.

The genus *Panorpodes* was founded by McLachlan in the Trans. Ent. Soc. of London, 1875, page 188 for a Japanese insect. The rostrum is short, and triangular; the 7th and 8th abdominal segments are not modified, but of the form of the 6th and previous ones. The tarsal claws are simple, and the wings unicolorous. Only one species has been recognized in North America. I have not been able to procure specimens of this species.

Panorpodes oregonensis McL.

Panorpodes oregonensis, *McLachlan*, Ent. Mo. Mag. 1881, 18-38.

Male very pale yellowish testaceous, the abdomen excepting the apex fuscescent above; ocelli shining blackish; eyes deep black, antennae dusky towards the tips; legs concolorous, the tips of the tibial and tarsal joints slightly blackish; the spinose hairs of tibiae and tarsi few, short and black; puvilli large, rounded, black; maxillary palpi having the 3rd and 4th joints conical not concave within; genae produced downward into a broad triangular tooth on each side of the face below the eyes; mentum with a slight triangular tooth on each side. Cheliferous segment oval, yellowish; claws short and stout, testaceous at the tips. Appendages viewed laterally prominent, thickened and outturned at the tips; viewed in front they consist of a long band-like piece slightly dilated at the apex, which is provided with two out-turned, slightly foliaceous branches;

the whole structure scarcely extending to the base of the claws. Wings wholly very pale shining flavescent, transparent, without markings, the pterostigmal regions slightly darker; neuration very pale; the transverse nervures conspicuously whitish, if the wings be held against the light; subcosta terminating about the middle of the costa in both pairs. (From the description of McLachlan). Female unkonwn.

Length of body 7-8 mm. Expanse 20-24 mm. Habitat, Mt. Hood, northern Oregon. Described from nine males.

Boreus Latr.

The genus *Boreus* was described by Latreille in 1825 in Cuvier's Animal Kingdom. It contains small dark colored, saltatorial insects. Wings of female rudimentary, of male imperfect; no ocelli present in either sex. The females differ from all others of the family in our fauna, in having a long protruding ovipositor, in some cases nearly as long as the abdomen. Only seven or eight species have been recognized.

Hagen has published a treatise of the genus in the Ent. Mon. Mag. 3–132, 1866. In this paper he considered two European species and the two species from eastern United States.

The following key will aid in separating the four species of our fauna:

1. Ovipositor at most little more than half as long as the abdomen, eastern species, ... 2.
   Ovipositor much more than half as long as the abdomen, western species, ... 3.
2. Legs fulvous with a narrow dark colored annulation at each joint, last three joints of tarsi black, *nivoriundus*.
   Legs and ovipositor black, . . . *brumalis*.
3. Legs and ovipositor brown, joints of the legs dark, almost black, base and apex of the ovipositor dark, *californicus*.
   Legs and ovipositor black, unicolorous, . *unicolor*.

Boreus nivoriundus Fitch.

Boreus nivoriundus, *Fitch*, Am. Jour. Agr. 5-277; *Fitch*, Trans. Ent. Soc. of London, 2nd series 1-96; *Hagen*, Neurop. N. A. 240; *Lintner*, 2nd Rep. Ins. N. Y. 237.

Length male 3½ mm., female 4½ mm. Basal joints of the antennae and middle portion of the rostrum fulvous, remainder of head and its appendages black; thorax and abdomen brown, legs, rudimentary wings and genitalia in both sexes light brown approaching fulvous, joints of the legs feebly black, two or three distal tarsal joints black, plate beneath the genitalia of the male triangular, truncate at the apex; female ovipositor about one half as long as the abdomen.

Habitat, N. Y.

Boreus brumalis Fitch.

Boreus brumalis, *Fitch*, Am. Jour. of Agr. 5-278; *Fitch*, Trans. Ent. Soc. of London, 2nd series 1-96; *Hagen*, Neurop. N. A. 240; *Lintner*, Sec. Report Ins. N. Y. 238.

Length, male 2½ mm., female including the ovipositor 4 mm. Black, metallic, all the appendages dark fuscous, ovipositor one half as long as the abdomen, plate beneath the male genitalia emarginate at the apex.

Habitat, N. Y.; D. C.; and Mich.

Boreus californicus Packard.

Boreus californicus, *Packard*, Proc. Bos. Soc. Nat. Hist. 1871, 8-408.

Length of female 5 mm., male 3½ mm. Head, thorax and abdomen metallic black, antennae and base and apex of rostrum black, middle of rostrum piceous, femora and tibiae light brown with the apices black, tarsal joints black, excepting the metatarsals, which are largely light brown; wing pads of the female, and imperfect wings of the male brown. Ovipositor brown, darker at base and apex; plate beneath male genitalia truncate at apex.

Specimens of this species were received from R. W. Doane, who took them at Pullman, Washington, on the snow in midwinter. He says that specimens have been taken in spring and early summer under stones. Packard's types were procured in northern California.

Boreus unicolor n. sp.

Length of female including the ovipositor 5 mm. Entirely black, without the striking metallic luster of *californicus*, and of *brumalis*. The ovipositor is nearly 2 mm. in length, being longer than any other North American species. The large size and long ovipositor separate it from our eastern forms and the black ovipositor and wing pads distinguish it from *californicus*.

Two female specimens in the Hubbard and Schwarz Collection, taken at Helena, Montana, on the 26th of April.

BITTACUS Latreille.

The genus *Bittacus* was described by Latreille in 1807, in Genera Crustaceorum et Insectorum to receive the European species *italica* Müller, *tipularia* Fabricus, which hitherto had been placed in *Panorpa*.

The head is small, and largely occupied by the conspicuous compound eyes. the mandibles are widest at the base, and gradually narrowed distally, the distal end is curved and pointed and preceded by a sharp tooth. The maxillae are peculiar in the large development of the maxillary palpi in comparison with the other parts; the labium is short bearing two-jointed palps at its distal end. The legs are longer than the wings, which are ample and in most cases without conspicuous markings.

Bittacus stigmaterus the first american species was described by Say in the Western Quarterly Reporter, 1823, 2-173. In 1836 Klug published in Abhandl. Acad. Wiss. Berlin, a description of *mexicanus* from Mexico. In 1841 Westwood described *pilicornis*, *punctiger* and *pallidipennis* in Trans. Ent. Soc. of London 4-195-6. In 1853 Walker described *occidentis* in Cat. Brit. Mus. 469. In 1861 Hagen, in his Synop. Neurop. N. A. 246, described *strigosus*, and on page 248 published for the first time, a description of *apicalis* from Uhler's manuscript; In the same work he announces that *pallidipennis* is synonomous with *stigmaterus*. In 1871 McLachlan described *apterus* in the Ent. Mon. Mag. 8-100, and in 1881 *chlorostigma* in the same periodical, 18-36.

The species of the genus differ in their food habits from the members of the genus *Panorpa*, as it is probable that they eat nothing but what they find living. Various insects are eaten by them, and there is no doubt that their predaceous habits make them of some value from an economic standpoint. Thus as they inhabit shady places along streams where mosquitos abound, it seems probable that mosquitoes form part of their bill of fare.

The following key will assist in locating the eight species of our fauna:

1. Both sexes wingless, ... *apterus.*
   Both sexes with wings, ... 2.
2. Hind femora and tibia thickened, cross veins of wings (except *punctiger*) not margined, . . . 3.
   Hind femora slender, cross veins of the wings margined with fuscous, ... 6.
3. Large dark colored species, pterostigma bright yellow, ... *chlorostigma.*
   Smaller species pterostigma not bright yellow, . 4.
4. Wings at base, and hind femora with black punctate spots, ... *punctiger.*
   Wings at apex fuscous, ... *apicalis.*
   Wings and hind femora unmarked, . . . 5.
5. Male appendages not protruding beyond the last segment of the abdomen, rounded at the distal end, *occidentis.*
   Male appendages protruding beyond the last segment, turned inward at apex, . . . *stigmaterus.*
6. Antennae with long pile, wings tastaceous, with the cross veins narrowly margined with fuscous, *piliconnis.*
   Antennae with short pile, wings pale, with the cross veins broadly margined with fuscous, . . *strigosus.*

Bittacus apterus McLachlan.

Plate LX, Fig. 15.

Bittacus apterus, *McLachlan*, Ent. Mo. Mag. 8-100; *Osten Sacken*, Wein. Ent. Zeit. 1-123; *McLachlan*, Ent, Nach. 19-317; *Hine*, Jour. Cal, Hort. Soc. 13-110.

Length of body 22 mm. male and female dark brown; head lighter in color than the thorax, ocelli prominent. not sur-

rounded by black, but the frontal one surmounted by one or two black spines. Thorax brownish, legs lighter, clothed with short pile and numerous black spinose hairs. Apex of tibial and tarsal joints of hind legs piceous, no wings or rudiments of wings.

Appendages of the male pale, wide, rather long, widest at apex, where superiorly there is a prominent elevation; basal part slightly prominent above, but below it is very strongly narrowed. Length 1½mm. Width at middle 1mm.

Easily known by the absence of wings.

Habitat, California.

Living specimens are said to have a green color agreeing with the plants on which they are found. Dry specimens vary some in color and the markings are somewhat obscured.

Bittacus chlorostigma McLachlin.

Plate LXI, Fig. 37.

Bittacus chlorostigma, *McLachlin*, Ent. Mo. Mag. 18-36; Ent. Nach. 19-317; *Hine*, Jour, Col. Hort. Soc. 13-110.

Male and female shining, reddish; wings transparent, shining, veins reddish, pterostigma yellow.

Appendages of the male lighter than the abdomen, extreme apex piceous, superior edge prominent, regularly concave, superior distal angle rounded, apex straight, inferior distal angle rounded, inferior edge very slightly concave to distal third, then strongly convex toward base making the appendage widest near basal third; 2½mm. in length and 1mm. in width. Anterior wing 24-27mm; body 23-26mm.

Habitat, southern Cal.

This is the only North American species of the genus having a yellow pterostigma, and also may be easily known by its large size.

Bittacus punctiger Westwood.

Plate LX, Fig. 19.

Bittacus punctiger, *Westwood*, Trans. Ent. Soc. of London 4-195; *Walker*, Cat. 468; *Hagen*, Neurop. N. A. 247; *Hine*, Jour. Col. Hort. Soc. 13-113.

Anterior wing 18 mm., length of body 17 mm. Yellowish; posterior femora with small black spots, wings yellowish, basal half with a few black spots, cross veins margined with fuscous.

Male appendages, from side view, not protruding beyond the abdomen, widest on basal half, apical part slightly narrower.

This species is easily known by the black spots on the femora and basal half of wing.

I procured specimens in the District of Columbia at intervals between June 25 and Aug. 1st, 1897, and again at the same place in 1899.

The specimens of this species that I saw, always remained close to the ground. If disturbed they never ventured above the herbage in which they were hiding, but flew a short distance through the foliage, and came to rest again near the surface.

Bittacus apicalis Uhler.

Plate LX, Fig. 16.

Bittacus apicalis, *Hagen*, Neurop. N. A. 248; *Hine*, Proc. Col. Hort. Soc. 13-109.

Body 16 mm., anterior wing 15-16 mm. Yellowish; thorax and abdomen often nearly black, wings hyaline black at apex.

Abdominal appendages of the male clothed with rather long yellowish hair; superior edge from side view, obliquely elevated to basal third, remainder regularly concave, superior distal angle a little less than a right angle, distal edge above nearly straight, below obliquely produced, making the inferior distal angle very prominent, the inner surface of this angle is furnished with numerous black teeth, inferior edge convex; a longitudinal thickening traverses the middle of the appendage for three-fourths of its length.

Habitat, Ark., June,; Ill. June,; N.Y.; Ohio, June-July; Va.; W. Va.

Bittacus occidentis Walker.

Plate LXI, Fig. 35.

Bittacus occidentis, *Walker*, Cat. Brit. Mus. 469; *Hagen*, Synop. Neurop. N. A. 247; *Hine*, Jour. Col. Hort. Soc. 13-112.

Length of body 16 mm., anterior wing 20 mm. Light

testaceous, wings yellowish with the veins a little darker, legs usually slightly darker than the abdomen, all of the tibiae black at apex.

Male appendages, as seen from above, reaching the extreme apex of abdomen, oblong, spreading, about the same width for their entire length, rounded, and slightly darker at the tips.

The female is not easily separated from that of *stigmaterus*, but the wings are narrower and usually darker colored. These characters are readily seen by comparing a series of the two species.

Habitat, Del.; D. C.; Ill.; Ind.; Penn.; Can.; Md.

I have examined fifteen males and females of this species. The narrow wings and uniform testaceous color are characteristic; the dark anterior and middle legs in fully matured specimens, is also peculiar to the species. This form has the peculiarity of appearing at lights. In correspondence with A. W. Butler of Brookeville, Ind., I received the following note which I insert with his permission: "About eight o'clock in the evening of Aug. 28, 1896, as I was passing one of the hotels of our city, I was called in to see some queer insects catch flies. I observed that they were very successful in their work, furnishing amusement for the hotel guests and others for a long time."

Hugo Kahl of Lawrence, Kansas, informs me that he took three specimens in his room on the evening of Sept. 25th, 1895.

F. C. Pratt, of the Div. Ent. at Washington, D. C., procured the species at light at Travilah, Md., July 9th, 1899.

Bittacus stigmaterus Say.

Plate LX, Fig. 20.

Bittacus stigmaterns, *Say*, Goodman's West. Quart. Rep. 2-164; Ent. Lec. Ed. 2-173; *Hagen*, Neurop. N. A. 247; *Hine*, Jour. Col. Hort. Soc. 13-114.

Battacus pallidipennis, Westwood; *Westwood*, Trans. Ent. Soc. Lon. 4-195; *Walker*, Cat. 468.

Bittacus mexicanus, Klug; *Hine*, Jour. Col. Hort. Soc. 13-111.

Anterior wing 18-21 mm., body 16-18 mm. Light brown; ocelli surrounded by black, eyes black, rostrum and maxillary palps black, the pile on the antennae is noticably longer than in *occidentis*, veins of wings prominent, hind femora thickened, the outer of the two spines at the end of each hind tibia as long as the first tarsal joint.

Male appendages, from side view, oblong, superior edge strongly elevated at base, nearly straight to apex, inferior edge very gradually approaching the superior, thus making the apex slightly narrower than the base; length of the appendages about 2 mm.

Habitat, D. C.; Ill.; Kans.; Md.; Mo.; N. Y.; Ohio; Ga.

Compared with *occidentis*, the male appendages are entirely different, the pile of the antennae is longer, the veins of the wings are more prominent. and the color of the wings is paler.

In a former paper I separated out a specimen which I called *mexicanus* Klug, principally on account of its larger size. After studying more material I am satisfied that it is *stigmaterus* and that the species is variable in size.

Bittacus pilicornis Westwoord.

Plate LX, Fig. 17.

Bittacus pilicornis, *Westwood*, Trans. Ent. Soc. of Lon. 4-196; *Walker*, Cat. 468; *Hagen*, Neurop. N. A. 246; *Hine*, Jour. Col. Hort. Soc. 13-113.

Anterior wing 19-21 mm., length of body 16-18 mm. Yellowish; antennae clothed with very long pile, wings yellowish, veins darker, cross veins bordered with fuscous, pterostigma prominent, yellowish brown, legs nearly the same color as the wings, hind femora not thickened.

The appendages of the male, from side view, triangular, with the corners rounded.

Haditat, Can.; D. C.; Md.; Mich.; N. Y.; Ohio.

Easily known by the long pile of the antennae. This is one of the two American forms without thickened posterior femora; the corresponding tarsal joints are also slender, and the wings are broad, with the apices broadly rounded.

The species is a strong flyer, and if molested often seeks retreat by flying into trees beyond the reach of collectors. I never have seen it abundant as we often find *strigosus* and *stigmaterus*.

Bittacus strigosus Hagen.

Plate LIX, Fig. 9.

Bittacus strigosus, *Hagen*, Synop. Neurop. N. A. 246; *Felt*, Lintner's 10th Rep. Ins. N. Y. 473; *Hine*, Jour. Col. Hort. Soc. 13-115.

Anterior wing 19 mm., length of body 17 mm. A pale colored species, wings pale, veins darker, cross veins broadly margined with fuscous.

Male appendages, from side view, long, prominent at base, superior edge straight nearly to middle, strongly concave from thence to apex, apex rounded, inferior edge irregularly concave to middle, where there is a prominent projection, nearly straight from thence to base.

Habitatat, Ark.; D. C.; Ill.; Kans.; Mass.; Mo.; N. Y.; Ohio; Pa.

The characteristics of this species, aside from the appendanges of the male, are the broad, pale wings with margined cross veins, and the slender hind femora. It is most nearly related to *pilicornis* from which it may easily be separated by the smaller size, and shorter pile on the antennae. Probably the most abundant and widely distributed *Bittacus* in our fauna.

MEROPE Newman.

Eyes large, reniform, antennae short, rather thick and pointed at the apex. Legs shorter than the wings, end of the abdomen with very long, two-jointed appendages.

This genus was founded by Newman in the Entomologists' Magazine for 1838, 5-180. Only one species has been described and this is so remarkable that it is questionable as to what family it belongs. Probably it has more characteristics with the *Panorpidae* than with any other group. Westwood after dissecting and studying the mouth parts placed it in this family. Hagen also gave it as his opinion that it should be placed here. Fitch believed that it is most nearly related to insects of the

genus *Nemoptera* which at the present time is not considered in *Panorpidae*. It may be mentioned that two arguments which Dr. Fitch produced against placing it in the *Panorpidae* do not seem so strong since we know more of the family. First, the short beak found in *Merope*, is approached by *Panorpodes*, an insect which is near enough to *Panorpa* to have the abdomen ended by a cheliferous segment. Second, *Merope* was taken in the evening at light; at least one species of *Battacus* has been taken at light several times.

Merope tuber Newman.

Merope tuber, *Newman*, Ent. Mag. 5-180; *Westwood*, Trans. Ent. Soc. Lon. 4-190 Plate 14, Fig. 2; *Fitch*, 14th Rep. Ent. N. Y. St. Agr. Soc. 373.

Expanse 28-32 mm; very pale yellowish; wings with numerous cross veins, each anterior wing with a small tubercle 1½ mm. from base of posterior border.

Appendages of the male long, composed of two sections, each section regularly curved, basal section 5½ mm., apical section 3½ mm., latter widened at apex.

The female has the same appearance as the male, but is smaller and has the end of the abdomen furnished with two appendages which are short, and composed of two segments.

Habitat, Orono, Maine; Penn.; N. Y.; D. C.

I have seen two males and three females.

EXPLANATION OF PLATES.

PLATE LIX.

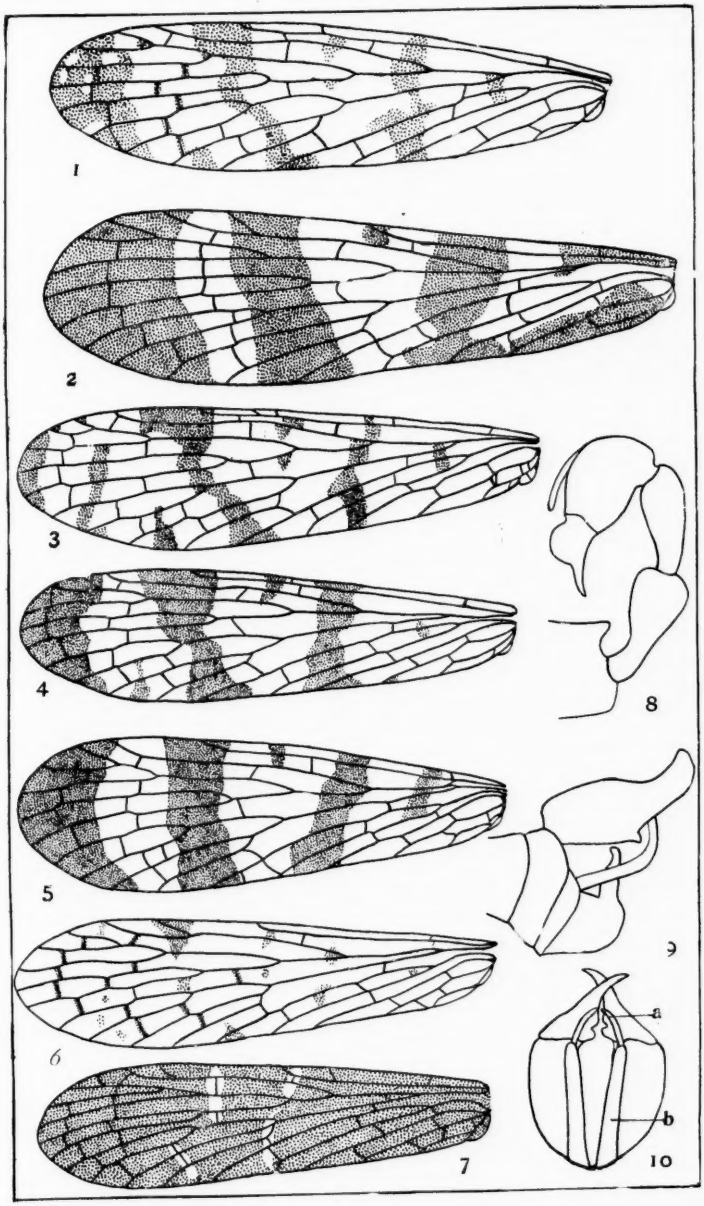
Wing of Panorpa, *1* female latipennis; *2* male nuptialis; *3* male latipennis; *4* male venosa; *5* female americana; *6* male maculosa; *7* male lugubris. Side view of the end of abdomen of male Panorpa, *8* signifer. Side view of end of abdomen of male Bittacus, *9* strigosus. Dorsal view of cheliferous segment of male Panorpa, *10* rufescens, (a) uncus, (b) harpe.

PLATE LX.

Wing of Panorpa, *11* female rufescens; *12* male signifer; *13* male confusa; *14* male claripennis; *21* male nebulosa; *22* male rufescens; *23* male venosa; *24* male canadensis. Side view of end of abdomen of male Bittacus, *15* apterus; *16* apicalis; *17* pilicornis; *19* puntiger; *20* stigmaterus. Dorsal view of cheliferous segment of male Panorpa, *18* venosa.

PLATE LXI.

Wing of Panorpa, *25* male subfurcata; *26* male nuptialis; *27* female confusa; *28* male banksii. Side view of end of abdomen of male Panorpa, *30* subfurcata; *31* rufescens; *32* latipennis; *36* claripennis; *38* venosa; *39* canadensis. Dorsal view of cheliferous segment of male Panorpa, *33* nuptialis; *34* confusa. Dorsal view of abdominal appendages of male Bittacus, *35* occidentis. Side view of the abdominal appendages of male Bittacus, *37* chlorostigma.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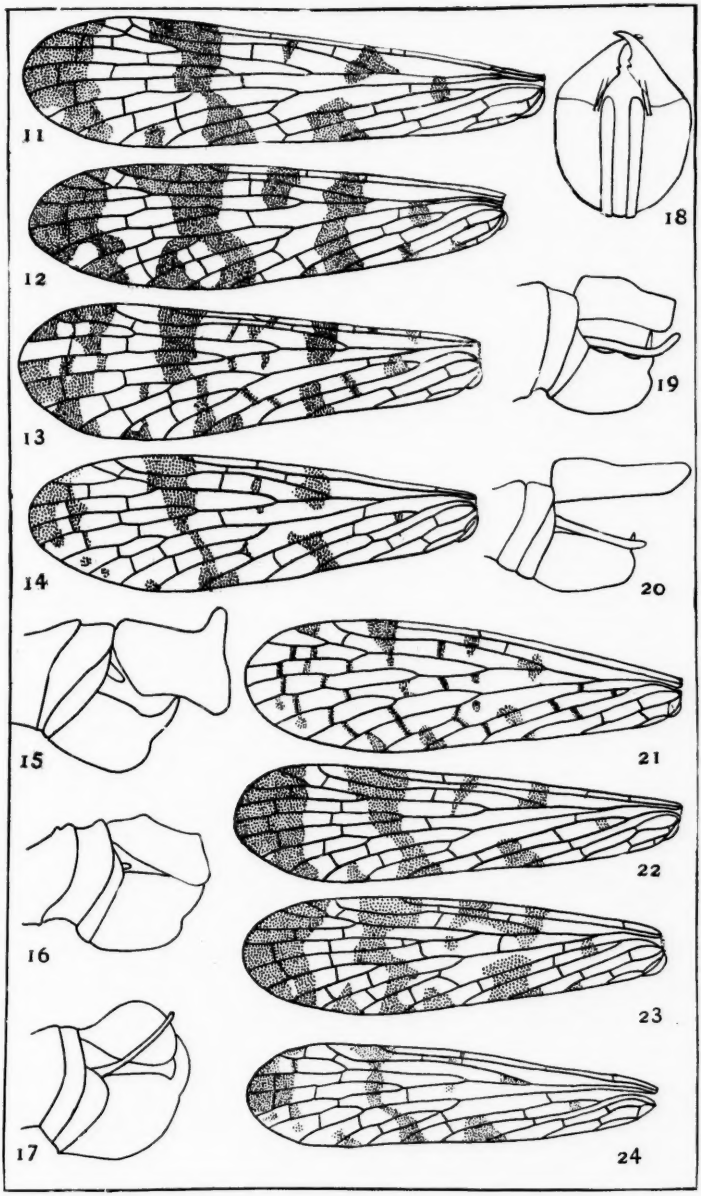
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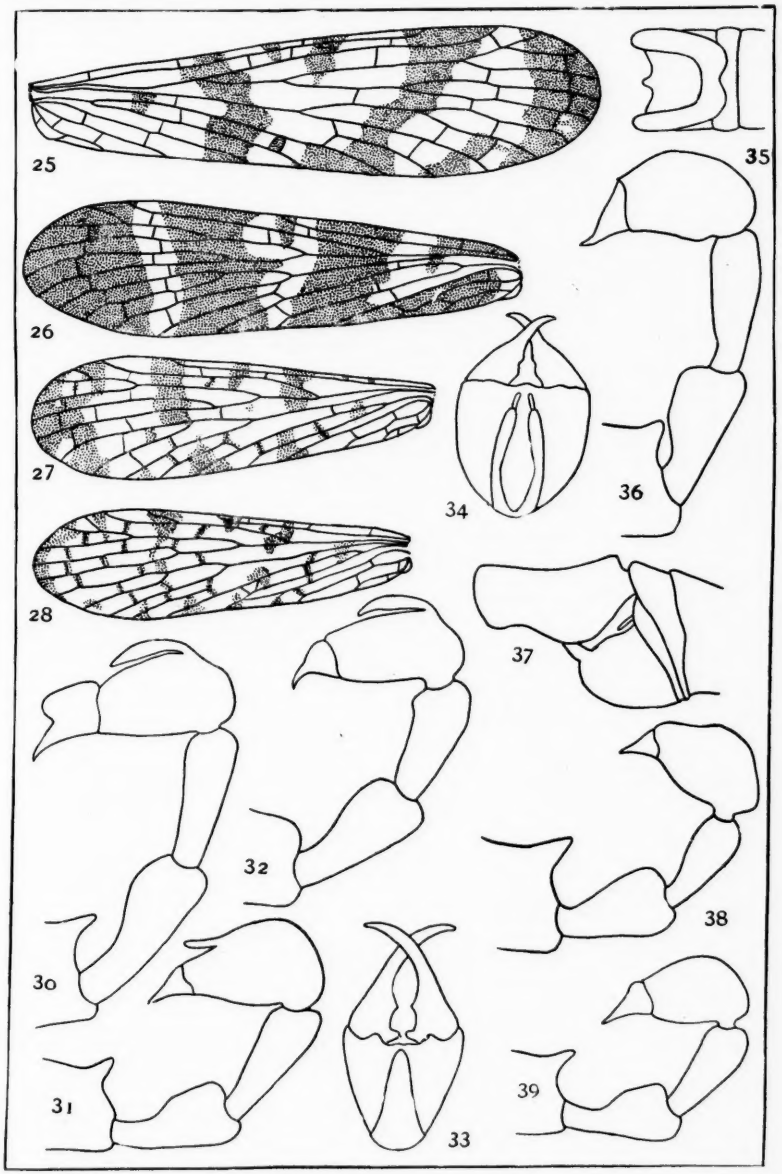
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